AeroSpace and Defence Industries Association of Europe

Food for Thought Paper

PADR-FPSS-OI-2017: Advanced soldier systems based on common European standard architectures

Basic Considerations

Interoperability of defence systems will be a key capability for future joint operations of EU-forces. For Land Defence Systems, interoperability of vehicles, infrastructures and soldier systems will be based on open standards and joint architectures.

Currently, there are several open architecture activities at EDA, NATO, UK, and USA which mainly address vehicles. They are seen as key to innovate the legacy approaches for armoured vehicle mission system and increase operational effectiveness through comprehensive networking and equipment flexibility, while at the same time ensure cost efficiency, reduce life cycle cost and enable state of the art upgrading.

With respect to soldier systems, such architectures are in their infancy. UK is most advanced in this domain with its initial version of a **Generic Soldier Architecture** (GSA) which was standardized as draft for discussion but the version which is intended to be implemented (Issue 3) is still under development.

At NATO, work is carried out in the **C4I and Systems Architecture** Team of Experts of **LCG DSS**, however only draft versions of a few views are currently available inside this group. Due to difficulties in personnel and, especially, the very recent step down of the chairmen, the future of this Team of Experts, at the moment, is unclear. STANAG 4677 was developed by the time some years ago and deals with multi-national C4I interoperability. It is currently being implemented by several nations.

Further, the **Power** Team of Experts of NATO LCG DSS works on standardization of power **connectors** for soldier systems (STANAG 4619, under ratification, and STANAG 4695 which needs an update). NATO also developed a standard on **Power rail** (STANAG 4740) which shall provide power to a device mounted on a weapon.

At EDA level, the paper Study Standard Architecture for Soldier Systems (STASS I) was completed recently. The study was focusing almost only on the power supply aspects and, thus, a second study STASS II with focus on data management, electrical, electronics and software is currently started. Deliverable is expected at the end of 2017. Additionally, several technology studies have been carried out under the Combat Equipment for Dismounted Soldier – Feasibility Study Program (CEDS FSP) umbrella.

The UK approach being the most advanced really defines a specific system for UK and is seen in many other nations as too narrow to fulfill all their requirements. It is therefore perceived as a specification for the Soldier Systems as subject of the upcoming UK procurement rather than suited as an international standard. However, it should be possible to develop an European approach which includes and complements the UK approach and does not contradict.

The activities at NATO are currently extremely slow and now even stopped due to internal reasons. NATO always welcomes contributions and, with the current situation of LCG DSS, a strong harmonized European approach would steer NATO in the right direction.

Both EDA studies are carried out with very low budget which drastically limited the results which could be achieved and only allowed very few major players to participate. The same is valid for the CEDS studies which suffered severely due to the extremely low budget.

A common European approach with respect to an open standard reference architecture is important and urgent as first experience and lessons learned being available by the few nations which possess modern soldier system and procurement. In many other European nations such solution will be requested in the next coming years. The cost savings and the superiority in situational awareness, survivability and effectiveness can best be achieved if a Soldier System Reference Architecture is available, standardized, and applied for the upcoming procurements.

Due to still lacking soldier system technologies supporting such an open architecture, technology studies need to be carried out with the necessary funding such that results substantially impact future soldier system developments.

European Land Defence Industry represented by ASD in Brussels suggests conducting a three years study on the definition and demonstration of a Generic Open Soldier System Reference Architecture within the Preparatory Action on Defence Research of the European Commission. The project should consist of a transversal part, in which the architecture shall be investigated, added by a first set of parallel projects on selected technologies, addressing TRL 2-4. At the end, a demonstration can be performed, in which the general function of the architecture will be presented, completed by preliminary demonstrations on focused technologies.

Specific Challenge

The current time period is characterized by rapid changes in many domains being it geopolitical, economic, environmental or technological ones. This dynamic environment has a direct impact on military operations, which are far less predictable, but almost always challenging. Time, type and place can take place across a wide spectrum and, therefore, future operations will be conducted by ad hoc combined (multi-national) coalitions of willing and able-nations with limited duration. At the same time, limited budgets are playing a major role, especially when equipping a larger number of soldiers.

This introduces important challenges to soldier systems, such as:

- Multi-National Interoperability;
- Operational Effectiveness;
- Adaptability to Military Mission and Mission Intensity;
- Maintaining Equipment at State of the Art;
- Life Cycle Cost Efficiency;
- Logistic and Human Resource footprint of force protection.

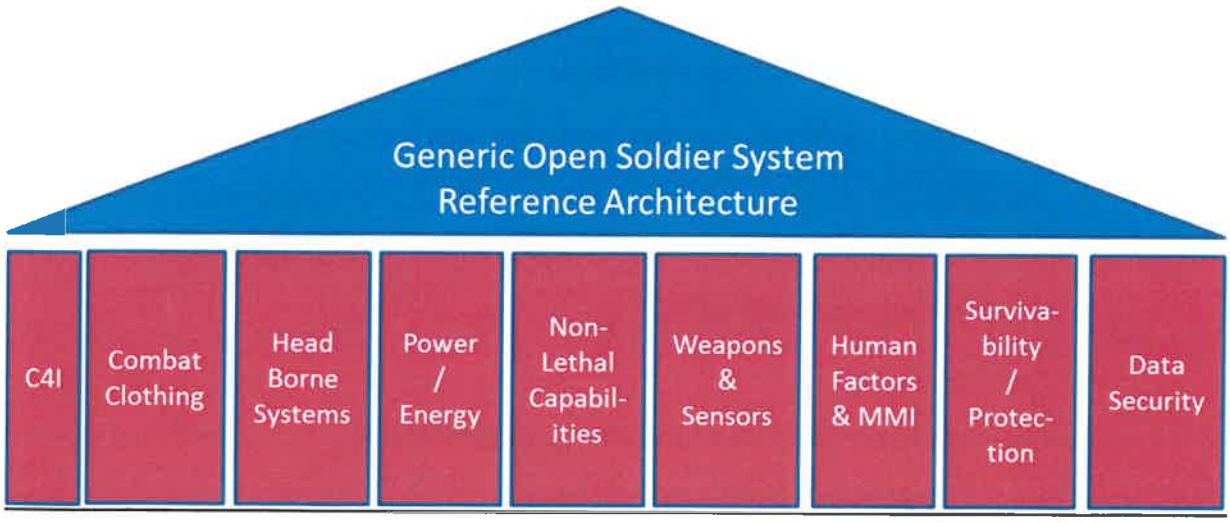
Scope

A project on Force Protection and advanced Soldier Systems based on common European standard Architectures should demonstrate clear progress beyond the state of the art in one or more of the aforementioned areas and activities with focus on:

- a Generic Open Soldier System Reference Architecture,
- supporting New and Advanced Technologies.

While the architecture shall ensure multi-national interoperability and enables state of the art equipment with reduced life cycle costs, it shall also allow easy adaptability to a wide range of military missions and mission intensities leading to operational effectiveness.

The Reference Architecture should thus optimally "organize" existing technology, while new technologies shall improve its building blocks and are equally important.



Generic Open Soldier System Reference Architecture

Definition of Architecture ready for standardization and comprehensively covering soldier systems within their context of operation (group, squad, multi-national, vehicles, etc.) with the intention to:

- promote interoperability and interchangeability for dismounted soldiers both at the system level and the component level, while preserving the information systems security (ISS);
- consider reduced cabling effort and, especially reduction of weight and size while keeping a suitable power budget;
- allow for a modular approach to:
    - support different soldier's equipment configurations as required by EU Member States,
    - equip the soldier for each mission with the most suited set of equipment that is readily interchangeable,
    - extend the modularity up to simple force protection solution (automatic detection, emerging threats);
- take into account the existing legacy components/systems when it does not drastically constraint the generic open architecture;
- allow for interface robots and/or mini-UAVs;
- require much lower integration efforts;
- allow incremental improvement of systems;
- enable insertion of new technology and promote innovation and diversity;
- increase component production numbers;
- increase competition of system integrators and suppliers but also reduce the investment for the supplier sharing same architecture concept;
- guide component developers;
- be geared towards standardisation;
- reduce life cycle costs;
- make best use of commercial-of-the-shelf products (COTS).

The architecture domain to be considered shall include:

- electronics;
- voice and data communication;
- software;
- human interface devices;
- sensors;
- effectors.

The architecture shall be based on a suitable architectural framework.

New and advanced Technologies

New and advanced technologies are sought in the areas of:

- C4I;
- Civil communications standards applied to defence;
- Robotics;
- Combat Clothing;
- Head Borne Systems;
- Power / Energy;
- Non-Lethal Capabilities;
- Weapons & Sensors;
- Human Factor including MMI;
- Survivability / Protection;
- Data Security;
- Simulation and training.

In particular, on the following topics: (examples)

- **Health monitoring sensors**

Health monitoring sensors are used to monitor the soldier's biological condition in terms of stress, dehydration or health in general. Work is requested on identifying and defining sensors and the appropriate information processing such that soldier can be better used during the operations with less negative impact on the individuals.

- **Augmented reality**

Augmented reality using, e.g. head up displays, immersive glasses or night vision googles can substantially increase situational awareness and improve coordination between individual soldiers. Work is requested on concepts for implementing and integration of augmented reality.

- **Night vision, high resolution, 3D and multi-spectral electro-optical devices**

Observation under reduced visibility caused by fog, smoke, sand rain, snow or just darkness during nighttime requires new technologies for electro-optical devices. Ideally, the soldier would just need a single device to cover all the cases, this will require a strong effort in automatization with smart sensors and data processing. A solution is required which may be based on one or different technologies, keeping in mind the Size, Weight and Power (SWaP) requirement for dismounted soldiers.

- **Dissemination of information between soldiers in and outside a squad**

Dissemination of information is a fundamental requirement for coordinating a squad and collecting and integrating situational awareness information. Depending on the role of the individual, more or less functionality is available and a concept is needed about what information shall be transmitted in which way which includes protocols and radio links. Information might cover C4I, audio, images, video, etc. Special emphasis shall be put onto the standardization of multi-national information exchange which is a major capability require for European forces.

- **Sensors connections**

Specific effort should be focused to secure sensors and effectors connections for intrusion and leakage in any operational situation from assault to protection.

- **C4ISTAR while eyes on target**

Operating computer displays draw much attention while the soldier neglects his environment and possible threads or targets. A capability is needed which enables the soldier to operate the C4ISTAR system, especially to extract his Situational Awareness or to enter coordination information or contacts and sightings without neglecting his attention to his environment. Attention should be paid to sharing of information horizontally and vertically while mastering this data protection.

- **Weapons**

New generation of weapons require interfaces with the soldier system including Head Electronic Sub-System (HESS), Weapon Electronic Sub-System (WESS), vest electronic sub-system. This will impact power supply concept, various add - on weapons, intra communication link, electronic sighting, MMI, and to revisit the operational concept of use. This could be applied from the basic rifle up to anti-armour missiles being capable of NLOS firing.

- **GPS equivalents and in-door localisation**

Determining position, orientation and especially directions for surveillance sensors, the weapon and the soldier's head is crucial for soldier's situational awareness when measuring and acquiring target for effective engagement. GPS equivalents are required as GPS is US owned and operated while recently also Galileo which is European operated is introduced and shows advantages. GPS equivalents are further required for determining positions when satellite signals are disturbed or not available is necessary. Additionally, solutions are required for positioning or navigation inside buildings which require an accurate system (i.e: IMU) for orientation determination. This has not been solved satisfactory yet because the often used compasses are not sufficiently accurate.

- **Auxiliary power technologies and small high power sources**

Today's soldiers mostly use some electrical or electronic devices (incl. IT devices) which need to be supplied with electrical power. For most current soldier systems, rechargeable batteries are used which, for today's power consumption requirements are too large and heavy and still have problems to provide enough energy for the extended time periods required during normal operations. Work on technologies is requested which is able to feed enough power into the system and enables operation of soldier systems for an extended time period. These technologies need to be small in weight and size such that they can be used during operation.

- **Tailor made blast and ballistic protection where relevant in accordance to NATO (STANAG 4569) standards**

Blast protection works best when it perfectly fits the soldier. However, today's production process requires certain standard sizes and shapes such that, for economic reasons, larger numbers can be produced. Especially 3D printing suggests that protection may be produced to fit perfectly onto the individual and therefore improves its protective characteristics. Investigations on the feasibility of protective material using 3D printing shall be investigated.

- **Highly sensitive and rapid detection of emerging threats used in hybrid warfare**

Dismounted Soldiers are regularly faced with explosives of any type, e.g. military mines or Improvised Explosive Devices (IEDs) which are found especially in hybrid warfare. Most recently they have been faced with explosive mini UAV's. There are still no reliable methods to rapidly detect such devices in time such that injuries can be avoided. Further work is therefore required.

- **5G for defence**

In addition to the classical military links, the use of, private or not, networks based on the civilian communications solutions should be considered, especially in an urban environment and for homeland protection. Specific issues like availability, integrity, security, etc. will need to be addressed to guarantee the quality of service expected for the military missions.

- **Manned/unmanned teaming (UGV/UAV)**

Specific functional interfaces and Man Machine Interface will be needed to allow the operation of, and the exchange of information with, unmanned vehicles used to directly support the

soldiers in their missions. Use of innovative concepts is to be considered for definition of new architectures allowing "plug & play" connections and a special effort is required in the MMI domain, considering the variety and diversity of soldier's missions and unmanned vehicles.

- **IFF and blue force tracking**

In modern and asymmetric warfare, the fratricide fires remain a high percentage of death and casualties. Most of the ground platforms are now equipped with IFF devices but without interoperability with the soldier (which is an issue in case of fire support from ground or air). Moreover, in-door IFF solutions are today not developed when, in modern conflicts, a number of fights are done inside buildings. The same applies for Blue Force Tracking for in-door and/or GPS denied environments.

Demonstration

Before activating the demonstration step, a clear concept of operations shall be established with performance allocation on all sub-systems. Finally, the following tasks should be carried out based on the developed reference architecture with new and advanced technologies for demonstration of its effectiveness:

- Define multi-national Demonstrator;
- Develop multi-national Demonstrator;
- Perform Demonstration;
- Refinement of Generic Open Soldier System Reference Architecture based on experience and feedback from demonstration.

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Signed by Jan Pie, ASD Secretary General, on 23 January 2017